Naval Oceanographic and
Atmospheric Research Laboratory

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SEVERE WEATHER GUIDE MEDITERRANEAN PORTS

34. BENIDORM

Naval Oceanographic and Atmospheric Research Laboratory,
Stennis Space Center, MS 39529-5004

CONTENTS

FOREWORD

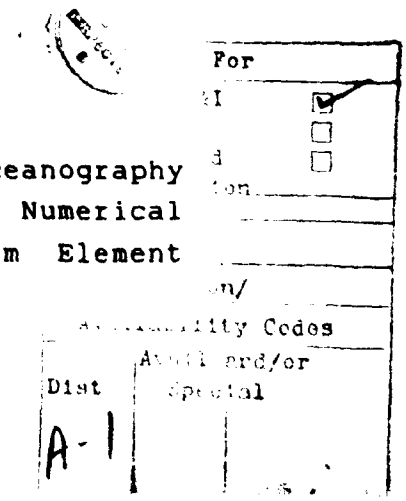
This handbook on Mediterranean Ports was developed as part of an ongoing effort at the Atmospheric Directorate, Naval Oceanographic and Atmospheric Laboratory (NOARL), Monterey, to create products for direct application to Fleet Operations. The research was conducted in response to Commander Naval Oceanography Command (COMNAVOCEANCOM) requirements validated by the Chief of Naval Operations (OP-096).

As mentioned in the preface, the Mediterranean region is unique in that several areas exist where local winds can cause dangerous operating conditions. This handbook will provide the ship's captain with assistance in making decisions regarding the disposition of his ship when heavy winds and seas are encountered or forecast at various port locations.

Readers are urged to submit comments, suggestions for changes, deletions and/or additions to Naval Oceanography Command Center (NAVOCEANCOMCEN), Rota with a copy to the oceanographer, COMSIXTHFLT. They will then be passed on to NOARL, Monterey for review and incorporation as appropriate. This document will be a dynamic one, changing and improving as more and better information is obtained.

ACKNOWLEDGMENTS

The support of the sponsors -- Naval Oceanography Command, Stennis Space Center, MS: and Fleet Numerical Oceanography Center, Monterey, CA (Program Element O&M,N) -- is gratefully acknowledged.



PORT INDEX

The following is a tentative prioritized list of Mediterranean Ports to be evaluated during the five-year period 1988-92, with ports grouped by expected year of the port study's publication. This list is subject to change as dictated by circumstances and periodic review. Computerized versions of these port guides are available for those ports with an asterisk (*). Contact the Atmospheric Directorate, NOARL, Monterey or NOCC Rota for IBM compatable floppy disk copies.

NO.	PORT
*1	GAETA, ITALY
*2	NAPLES, ITALY
*3	CATANIA, ITALY
*4	AUGUSTA BAY, ITALY
*5	CAGLIARI, ITALY
*6	LA MADDALENA, ITALY
7	MARSEILLE, FRANCE
8	TOULON, FRANCE
9	VILLEFRANCHE, FRANCE
10	MALAGA, SPAIN
11	NICE, FRANCE
12	CANNES, FRANCE
13	MONACO
14	ASHDOD, ISRAEL
15	HAIFA, ISRAEL
16	BARCELONA, SPAIN
17	PALMA, SPAIN
18	IBIZA, SPAIN
19	POLLENSA BAY, SPAIN
20	LIVORNO, ITALY
21	LA SPEZIA, ITALY
22	VENICE, ITALY
23	TRIESTE, ITALY
*24	CARTAGENA, SPAIN
*25	VALENCIA, SPAIN
*26	SAN REMO, ITALY
*27	GENOA, ITALY
*28	PORTO TORRES, ITALY
*29	PALERMO, ITALY
*30	MESSINA, ITALY
*31	TAORMINA, ITALY

1991	PORT
*32	TARANTO, ITALY
*33	TANGIER, MOROCCO
*34	BENIDORM, SPAIN
35	ROTA, SPAIN
36	LIMASSOL, CYPRUS
37	LARNACA, CYPRUS
38	ALEXANDRIA, EGYPT
39	PORT SAID, EGYPT
	SOUSSE, TUNISIA
	SFAX, TUNISIA
	TUNIS, TUNISIA
	BIZERTE, TUNISIA
	SOUDA BAY, CRETE
	VALETTA, MALTA
	PIRAEUS, GREECE

1992	PORT
	KALAMATA, GREECE
	CORFU, GREECE
	KITHIRA, GREECE
	THESSALONIKI, GREECE

	DELAYED INDEFINITELY
	ALGIERS, ALGERIA
	ISKENDERUN, TURKEY
	IZMIR, TURKEY
	ISTANBUL, TURKEY
	ANTALYA, TURKEY
	GOLCUK, TURKEY

PREFACE

Environmental phenomena such as strong winds, high waves, restrictions to visibility and thunderstorms can be hazardous to critical Fleet operations. The cause and effect of several of these phenomena are unique to the Mediterranean region and some prior knowledge of their characteristics would be helpful to ship's captains. The intent of this publication is to provide guidance to the captains for assistance in decision making.

The Mediterranean Sea region is an area where complicated topographical features influence weather patterns. Katabatic winds will flow through restricted mountain gaps or valleys and, as a result of the venturi effect, strengthen to storm intensity in a short period of time. As these winds exit and flow over port regions and coastal areas, anchored ships with large 'sail areas' may be blown aground. Also, hazardous sea state conditions are created, posing a danger for small boats ferrying personnel to and from port. At the same time, adjacent areas may be relatively calm. A glance at current weather charts may not always reveal the causes for these local effects which vary drastically from point to point.

Because of the irregular coast line and numerous islands in the Mediterranean, swell can be refracted around such barriers and come from directions which vary greatly with the wind. Anchored ships may experience winds and seas from one direction and swell from a different direction. These conditions can be extremely hazardous for tendered vessels. Moderate to heavy swell may also propagate outward in advance of a storm resulting in uncomfortable and sometimes dangerous conditions, especially during tending, refueling and boating operations.

This handbook addresses the various weather conditions, their local cause and effect and suggests some evasive action to be taken if necessary. Most of the major ports in the Mediterranean will be covered in the handbook. A priority list, established by the Sixth Fleet, exists for the port studies conducted and this list will be followed as closely as possible in terms of scheduling publications.

RECORD OF CHANGES

CHANGE NUMBER	DATE OF CHANGE	DATE ENTERED	PAGE NUMBER	ENTERED BY

1. GENERAL GUIDANCE

1.1 DESIGN

This handbook is designed to provide ship captains with a ready reference on hazardous weather and wave conditions in selected Mediterranean harbors. Section 2, the captain's summary, is an abbreviated version of section 3, the general information section intended for staff planners and meteorologists. Once section 3 has been read, it is not necessary to read section 2.

1.1.1 Objectives

The basic objective is to provide ship captains with a concise reference of hazards to ship activities that are caused by environmental conditions in various Mediterranean harbors, and to offer suggestions for precautionary and/or evasive actions. A secondary objective is to provide adequate background information on such hazards so that operational forecasters, or other interested parties, can quickly gain the local knowledge that is necessary to ensure high quality forecasts.

1.1.2 Approach

Information on harbor conditions and hazards was accumulated in the following manner:

A. A literature search for reference material was performed.
B. Cruise reports were reviewed.
C. Navy personnel with current or previous area experience were interviewed.
D. A preliminary report was developed which included questions on various local conditions in specific harbors.
E. Port/harbor visits were made by NOARLW personnel; considerable information was obtained through interviews with local pilots, tug masters, etc; and local reference material was obtained.
F. The cumulative information was reviewed, combined, and condensed for harbor studies.

1.1.3 Organization

The Handbook contains two sections for each harbor. The first section summarizes harbor conditions and is intended for use as a quick reference by ship captains, navigators, inport/at sea OOD's, and other interested personnel. This section contains:

A. a brief narrative summary of environmental hazards,
B. a table display of vessel location/situation, potential environmental hazard, effect-precautionary/evasion actions, and advance indicators of potential environmental hazards,
C. local wind wave conditions, and
D. tables depicting the wave conditions resulting from propagation of deep water swell into the harbor.

The swell propagation information includes percent occurrence, average duration, and the period of maximum wave energy within height ranges of greater than 3.3 feet and greater than 6.6 feet. The details on the generation of sea and swell information are provided in Appendix A.

The second section contains additional details and background information on seasonal hazardous conditions. This section is directed to personnel who have a need for additional insights on environmental hazards and related weather events.

1.2 CONTENTS OF SPECIFIC HARBOR STUDIES

This handbook specifically addresses potential wind and wave related hazards to ships operating in various Mediterranean ports utilized by the U.S. Navy. It does not contain general purpose climatology and/or comprehensive forecast rules for weather conditions of a more benign nature.

The contents are intended for use in both previsit planning and in situ problem solving by either mariners or environmentalists. Potential hazards related to both weather and waves are addressed. The

oceanographic information includes some rather unique information relating to deep water swell propagating into harbor shallow water areas.

Emphasis is placed on the hazards related to wind, wind waves, and the propagation of deep water swell into the harbor areas. Various vessel locations/situations are considered, including moored, nesting, anchored, arriving/departing, and small boat operations. The potential problems and suggested precautionary/evasive actions for various combinations of environmental threats and vessel location/situation are provided. Local indicators of environmental hazards and possible evasion techniques are summarized for various scenarios.

CAUTIONARY NOTE: In September 1985 Hurricane Gloria raked the Norfolk, VA area while several US Navy ships were anchored on the muddy bottom of Chesapeake Bay. One important fact was revealed during this incident: Most all ships frigate size and larger dragged anchor, some more than others, in winds of over 50 knots. As winds and waves increased, ships 'fell into' the wave troughs, BROADSIDE TO THE WIND and become difficult or impossible to control.

This was a rare instance in which several ships of recent design were exposed to the same storm and much effort was put into the documentation of lessons learned. Chief among these was the suggestion to evade at sea rather than remain anchored at port whenever winds of such intensity were forecast.

2. CAPTAIN'S SUMMARY

The city of Benidorm is located on the Costa Blanca (White Coast) of Spain south of Valencia and north of Cartagena (Figure 2-1)

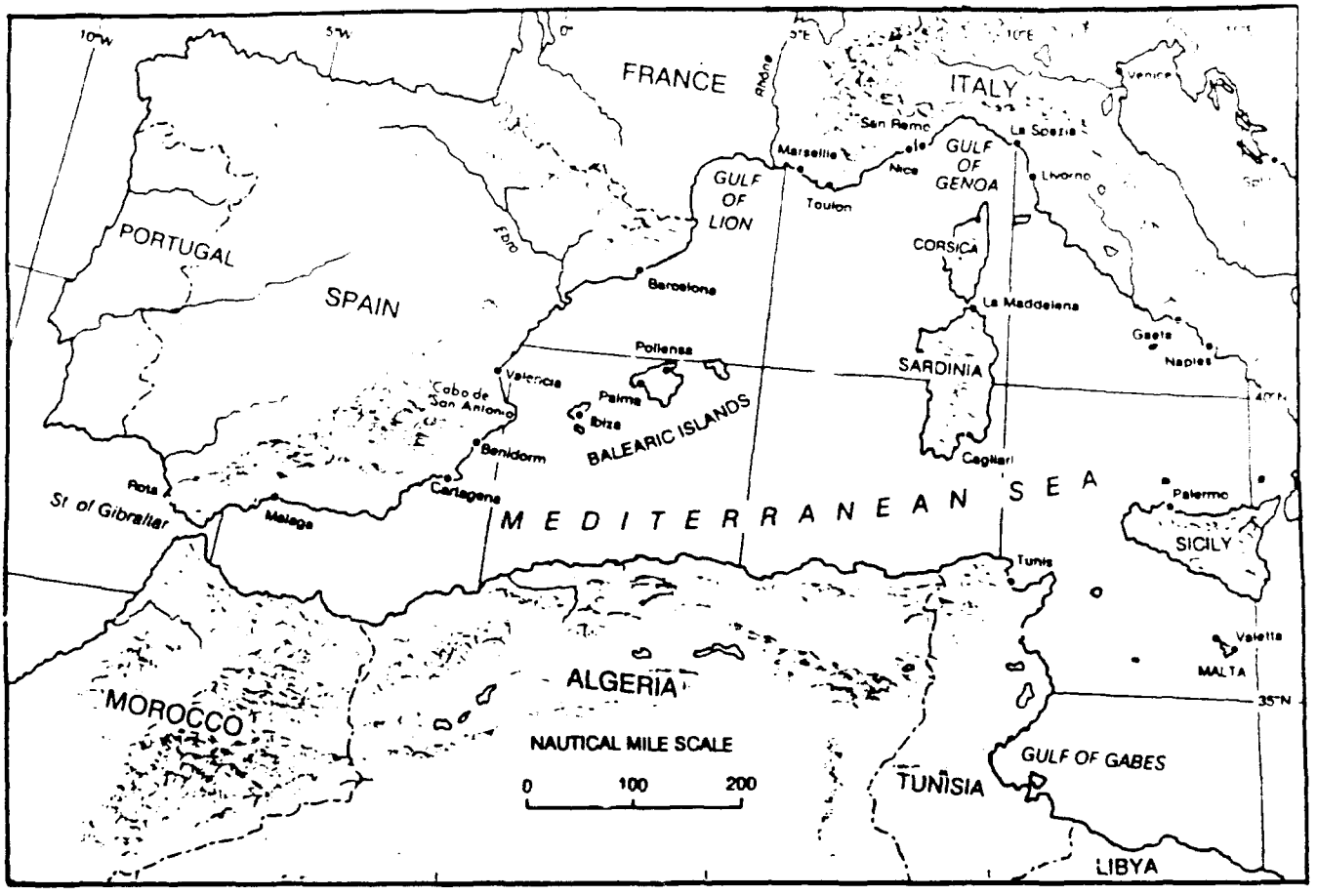


Figure 2-1. Western Mediterranean Sea.

The Port of Benidorm is located at 38° 32'N 0° 8'W (Figure 2-2). The coastline is situated east-west at this point and the Bay of Benidorm is open to the south.

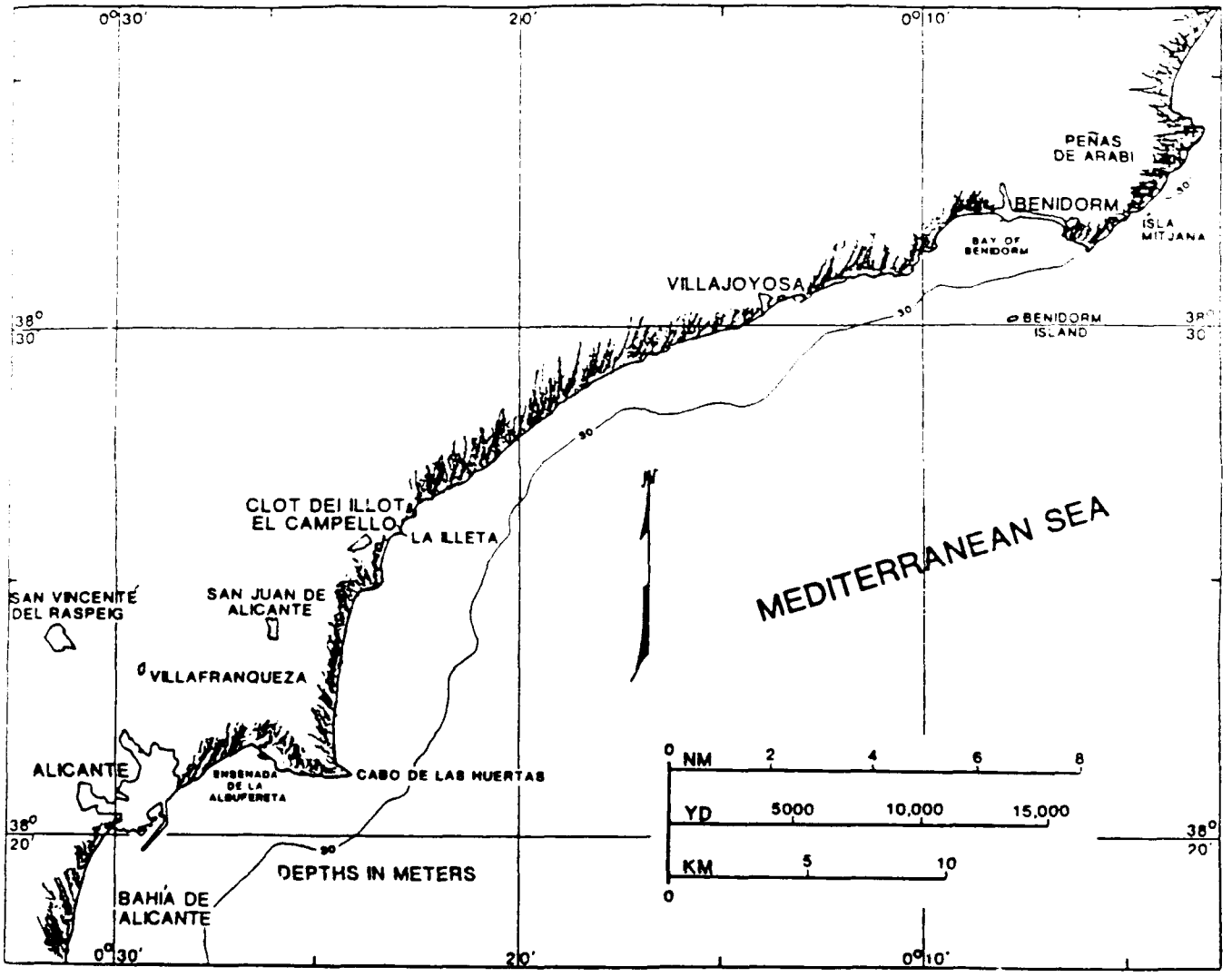


Figure 2-2. Costa Blanca on Spain's east coast.

The Port of Benidorm consists only of an unnamed breakwater pier and a small yacht harbor behind the pier (Figure 2-3). There are no berths in Benidorm and U.S. Navy ships anchor out.

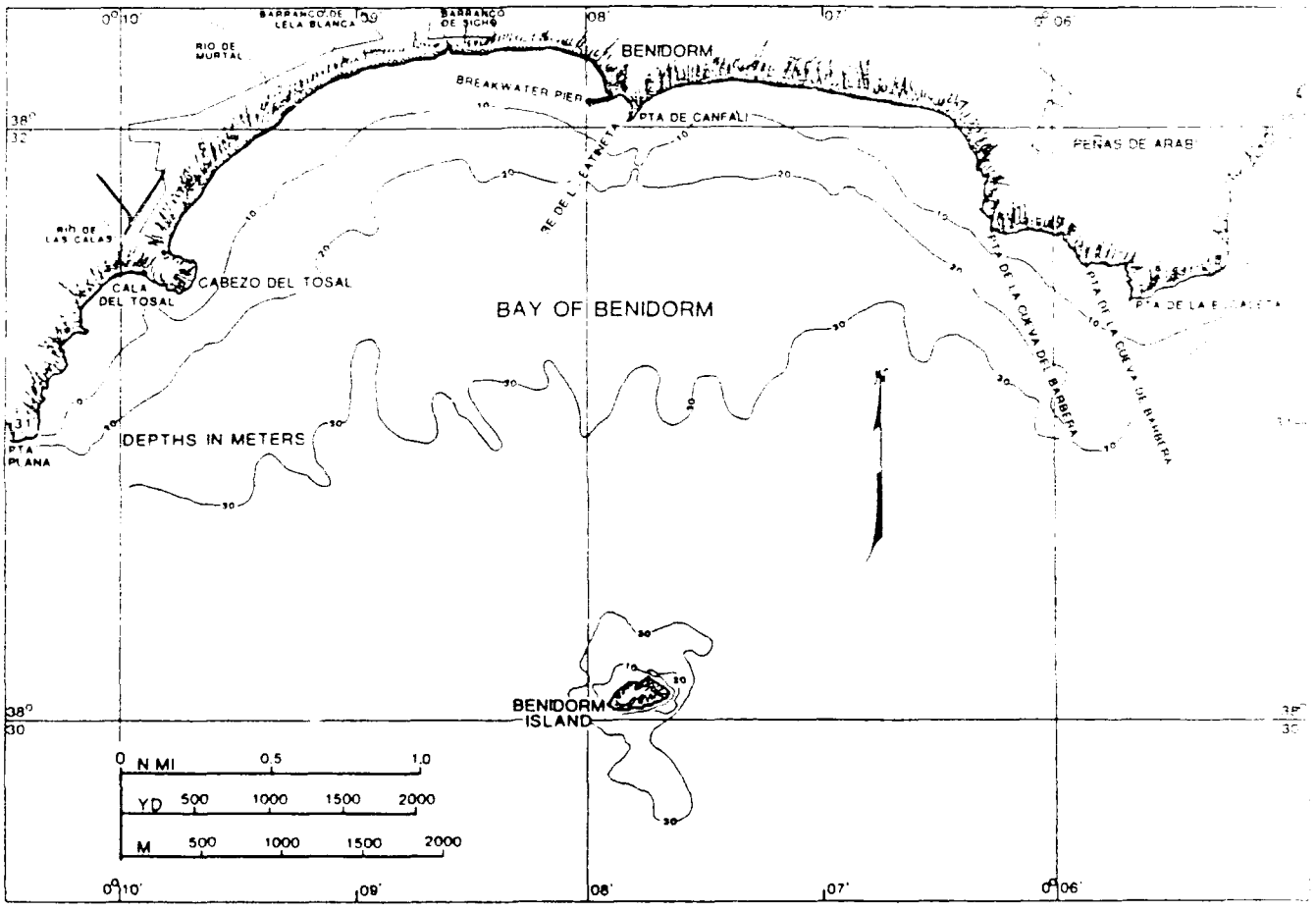


Figure 2-3. Bay of Benidorm.

The non-carrier anchorage is approximately 750 yards (685 m) southwest of the end of the breakwater pier in depths of 65 to 80 feet (20 - 25 m). Holding ground is mud and seaweed. Carrier anchorage is 2200 yards (2013 m) south-southwest of the other anchorage in depths of 105 to 115 feet (32 - 35 m). Holding ground is sandy. Fleet landing is on the north side of the pier near the yacht harbor and is well protected.

The port is somewhat protected by mountains to the north and west and by hills to the northeast through east-southeast. It is open to winds from the southwest, south and southeast. The anchorage areas are similarly exposed with additional exposure to easterly winds, especially at the carrier anchorage. Although the port is not exposed to easterly winds, easterly swell will traverse along the coastline and be felt at the breakwater pier. Easterly swell will also affect both anchorage areas. The easterly wind, known as the Levante, can occur anytime of the year but is stronger in winter and early spring. A summertime Levante often seems as strong as a winter Levante due to enhancement by the afternoon sea breeze.

Because the Bay of Benidorm is exposed to the south, the most troublesome condition is the southwesterly (Vendaval) to southeasterly (Scirocco) wind. These winds precede cold fronts which usually occur in the cooler months. Scirocco winds occur a few times a year and may be accompanied by the 'red rain', dust mixed in with the rain drops. This rain/dust mixture can seep into unprotected equipment vents, doors, etc.

Mistral winds occur as northeasterlies between mainland Spain and the Balearic Islands. Because of the configuration of the Bay of Benidorm, Mistral effects are minimized and only moderate easterly winds and/or long period swell are felt in the Bay.

Table 2-1. Summary of hazardous environmental conditions for the Port of

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT
1. Levante winds/waves - E'ly/NE'ly winds which can cause high waves at anchorage. * Occurs year-round, strongest in winter and spring. * Caused by Azores high extending into Spain or with low pressure system to the south of the Balearic Islands. * In cool season, usually accompanied by low clouds and rain. * E'ly to SE'ly Levante will often precede cold fronts in winter/early spring.	Advance warning * A low NE or ENE swell can be observed 12 hr in advance of wind onset along coast. * If an intense low is south of the Balearics, strong Levante winds can be expected at the anchorages.	(1) Anchorages.	a. Although r... ships in ... * Due to ... swel... ... * 25 to 3... ... or ...
		(2) Arriving/Departing.	(a) Use caut... encounter...
		(3) Small boats.	(a) Boat runs * Winds ... causing ... create ... * During ... speeds.
2. Vendaval winds - Sw'ly to W'ly winds which precede cold fronts. * Can be gale force (34 to 47 kt) with well defined cold front. * Largest wave heights come from southerly direction due to large fetch.	Advance warning * Any cold front approaching Spain's east cost from the west has the potential to cause strong Vendaval winds. Note that fronts will weaken as they approach coast but will intensify after passing the coast and interacting with the lee trough.	(1) Anchorages.	a. In extreme... force ... * Intense ... * A more ... the ar... due to ...
		(2) Arriving/Departing.	(a) Use caut... west'erly ...
		(3) Small boats.	(a) Boating w... * Runs to ... winds w... * Winds c... causing ... * A previ... due to ...

(A)

nmental conditions for the Port of Benidorm, Spain.

VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
1. Anchorages.	(a) Although rare, high winds/waves at anchorages may force ships to protect at sea or seek shelter. • Due to long fetch from E and ENE, 8 to 10 foot (3-3.5 m) swell is possible even with winds of only 20 kt. • 25 to 35 kt winds with rainshowers can last off and on for 3 or 4 days.
2. Arriving/Departing.	(a) Use caution on departure to the east as high waves can be encountered just past the end of Punta de la Escaleta.
3. Small boats.	(a) Boat runs to/from anchorages may be curtailed. • Winds can change direction quickly, especially in winter, causing waves to cross at dangerous angles to the winds and create hazardous conditions for small boats. • During summer levante, afternoon sea breeze can enhance wind speeds. *Morning runs should be scheduled.*
1. Anchorages.	(a) In extremely rare cases high winds/waves at anchorages may force ships to protect at sea. • Intense Vendaval episodes are usually of short duration (3-6 hrs). • A more southerly Vendaval direction will bring higher waves to the anchorages than will southwesterly or westerly Vendavals due to fetch distances.
2. Arriving/Departing.	(a) Use caution if anchoring during frontal passage. Winds can be westerly while waves are southerly.
3. Small boats.	(a) Boating will usually be affected. • Runs to/from the anchorages may be curtailed due to hazardous winds/waves at the anchorage. • Winds can change direction quickly, especially in winter, causing waves to cross at dangerous angles to the winds. • A previous summer incident stranded crew ashore for 72 hours, due to 25 to 30 kt winds.

Table 2-1 (continued)

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - E
3. Mistral wind/waves - Swell from a Mistral event in the Gulf of Lion can extend southward, arriving as an easterly swell in the Bay of Benidorm. * Mistral outbreaks occur most frequently in late winter and early spring. * In rare cases (1-2 times a year), strong easterly (25+ kt) Mistral winds will be felt in the Benidorm area. * More often (2-3 times per year), long-period (15 sec) easterly swell, with or without the wind, will affect the anchorage area. Swell is usually less than 6 feet.	Advance warning * A strong Mistral event (40+ kt) in the Gulf of Lion will normally produce some swell in the Benidorm area (see the Severe Weather Guide for Marseille or Toulon for details).	(1) Anchorages.	(a) Swell * Be the ar to (E cri
		(2) Arriving/Departing.	(a) Use Mist will
		(3) Small boats.	(a) Boati * Run haz * Win caus and

tinued)

SSEL LOCATION/ TION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
...horages.	(a) Swell will more likely be a problem than wind. * Between the coast and Ibiza, the wind and swell are from the northeast. The swell refracts around the coastline, arriving as an easterly swell. High terrain causes the wind to also become easterly as in crosses the Bay. Long period (15 sec) swell may cause excessive motion on ships with critical response characteristics.
...roving/Departing.	(a) Use caution on departure toward the north or east as the Mistral will have minimal effect in the bay while high waves will be experienced once clear of Cabo de San Antonio.
...all boats.	(a) Boating operations will be minimally affected. * Runs to/from the outer anchorage may be curtailed due to hazardous winds and or swell at the anchorage. * Winds can change direction quickly, especially in winter, causing waves to cross at dangerous angles to the winds and create hazardous conditions.

SEASONAL SUMMARY OF WEATHER CONDITIONS
(Much of this information adapted from Brody and Nestor, 1980).

WINTER (November thru February):

* Levante wind (easterly) can precede cold front or occur when low is south of Balearics.
* Easterly swell can occur with or without the wind and affect the anchorage areas.
* Vendaval (southwesterly) may follow the Levante. Both winds can be in 30-35 kt range.
* Most common wind direction in winter is westerly, 15 kt occasionally 30 kt. Fetch is limited, waves minimal.

SPRING (March thru May):

* Early spring similar to winter. Sea breezes occur on warm days.
* Increase in Levante occurrences but a decrease in average wind speed.
* Thunderstorms start occurring in April, 1-2 per month.

SUMMER (June thru September):

* 50% of winds from northeast to southeast.
* Moderate sea breeze daily occurrence.
* Thunderstorms possible throughout summer, 1-2 occurrences per month with infrequent gusts to 45 kt.

AUTUMN (October):

* Short transition season as winter weather returns by end of month.
* Thunderstorms occur 2-3 times in October.

NOTE: For more detailed information on hazardous weather conditions see previous Summary Table in this section and Hazardous Weather Summary in Section 3.

REFERENCES

Brody, L.R. and M.J.R. Nestor, 1980: Regional Forecasting Aids for the Mediterranean Basin, NAVENVPREDRSCHFAC Technical Report TR 80-10. Naval Oceanographic and Atmospheric Research Laboratory, Atmospheric Directorate*, Monterey, CA 93943-5006.

FICEURLANT, 1985: Port Directory for Benidorm (revised 1987). Fleet Intelligence Center Europe and Atlantic, Norfolk, VA.

Port Visit Information

JANUARY 1989. NOARL meteorologists R. Fett and D. Perryman met with the U.S. Navy husbanding agent, Mr. John Sparrowe, to obtain much of the information included in this port evaluation.

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* Formerly the Naval Environmental Prediction Research Facility.

3. GENERAL INFORMATION

The information in this section is intended for fleet meteorologists/oceanographers and staff planners. Paragraph 3.5 provides a general discussion of winds and weather and Table 3-1 presents a summary of hazards and actions by season.

3.1 Geographic Location

The city of Benidorm is located on the Costa Blanca (White Coast) of Spain south of Valencia and north of Cartagena (Figure 3-1).

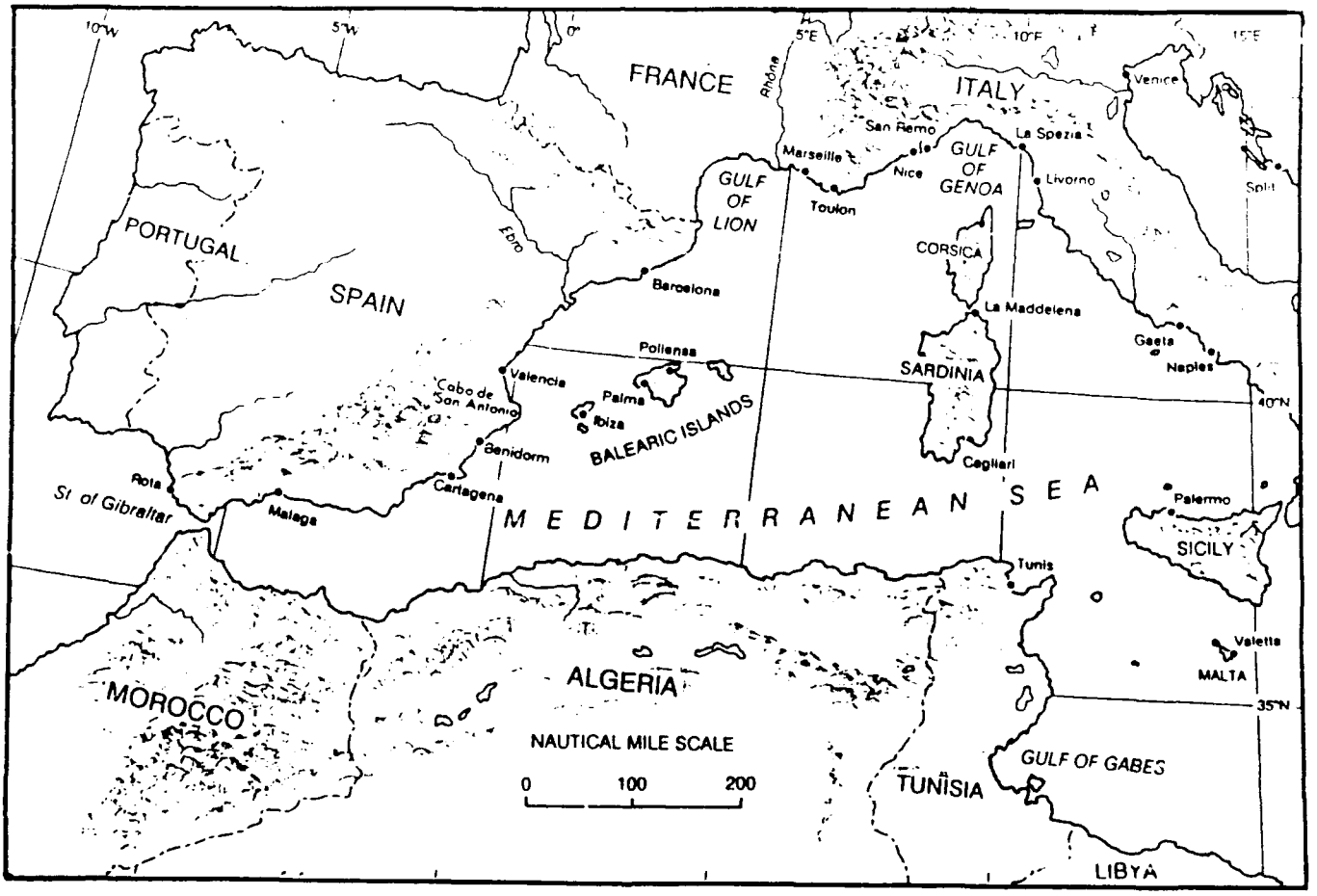

Figure 3-1. Western Mediterranean Sea.

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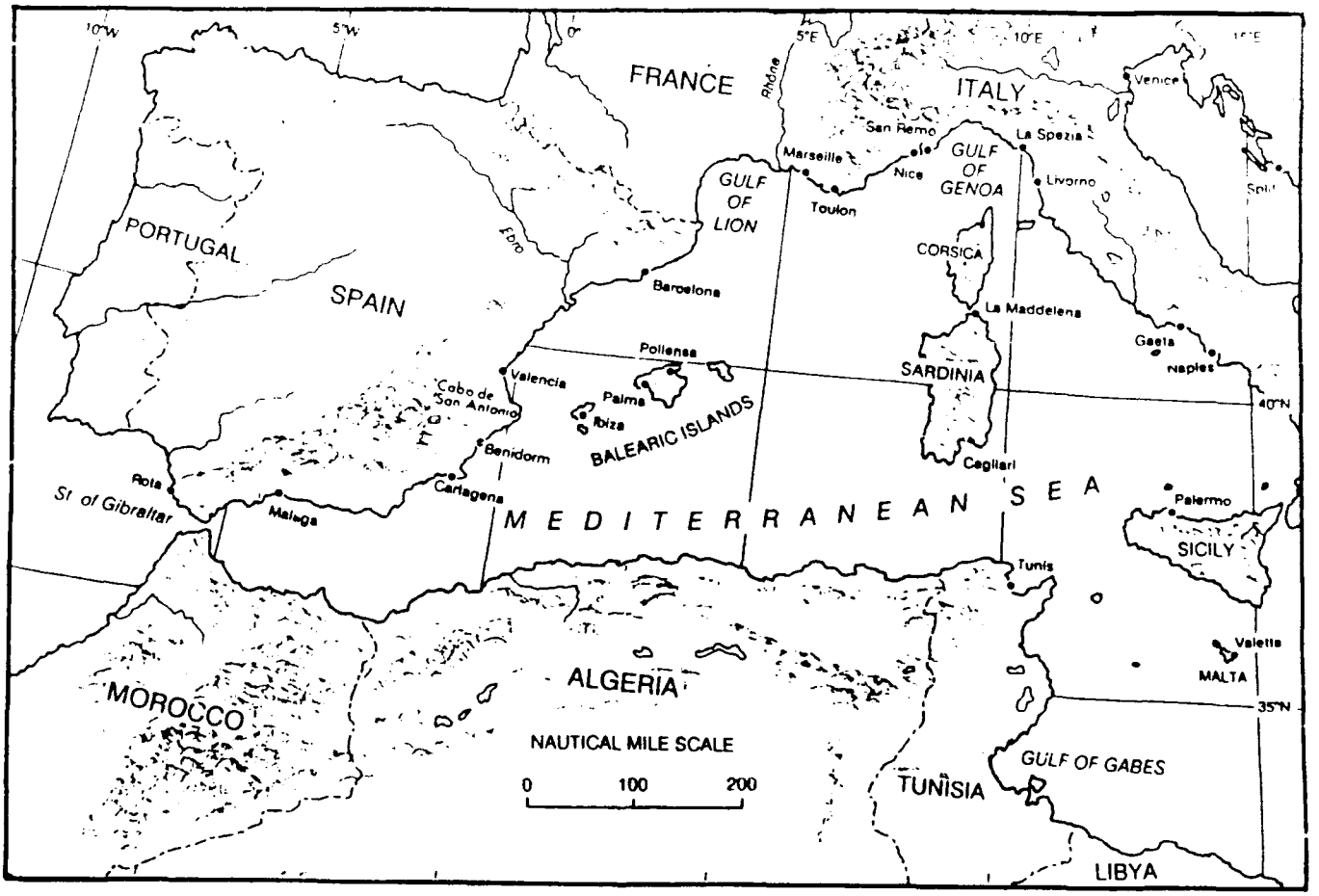

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The Port of Benidorm is located at 38° 32'N 0° 8'W (Figure 3-2). The coastline is situated east-west at this point and the Bay of Benidorm is open to the south.

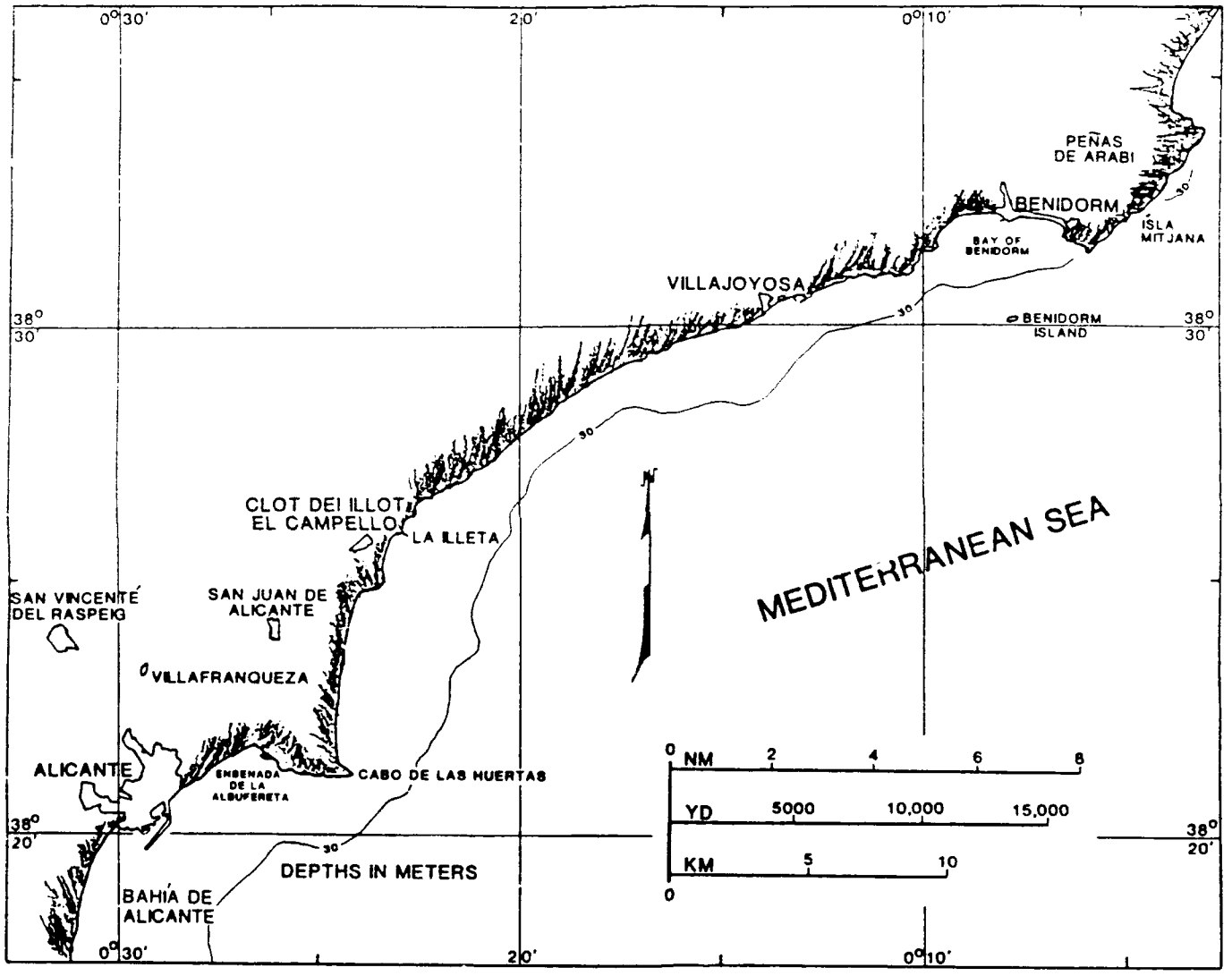

Figure 3-2. Costa Blanca on Spain's east coast.

The Port of Benidorm consists only of an unnamed breakwater pier and a small yacht harbor behind the pier (Figure 3-3). There are no berths in Benidorm and U.S. Navy ships anchor out. Benidorm is a popular resort city and the population quadruples during the summer months, peaking in August.

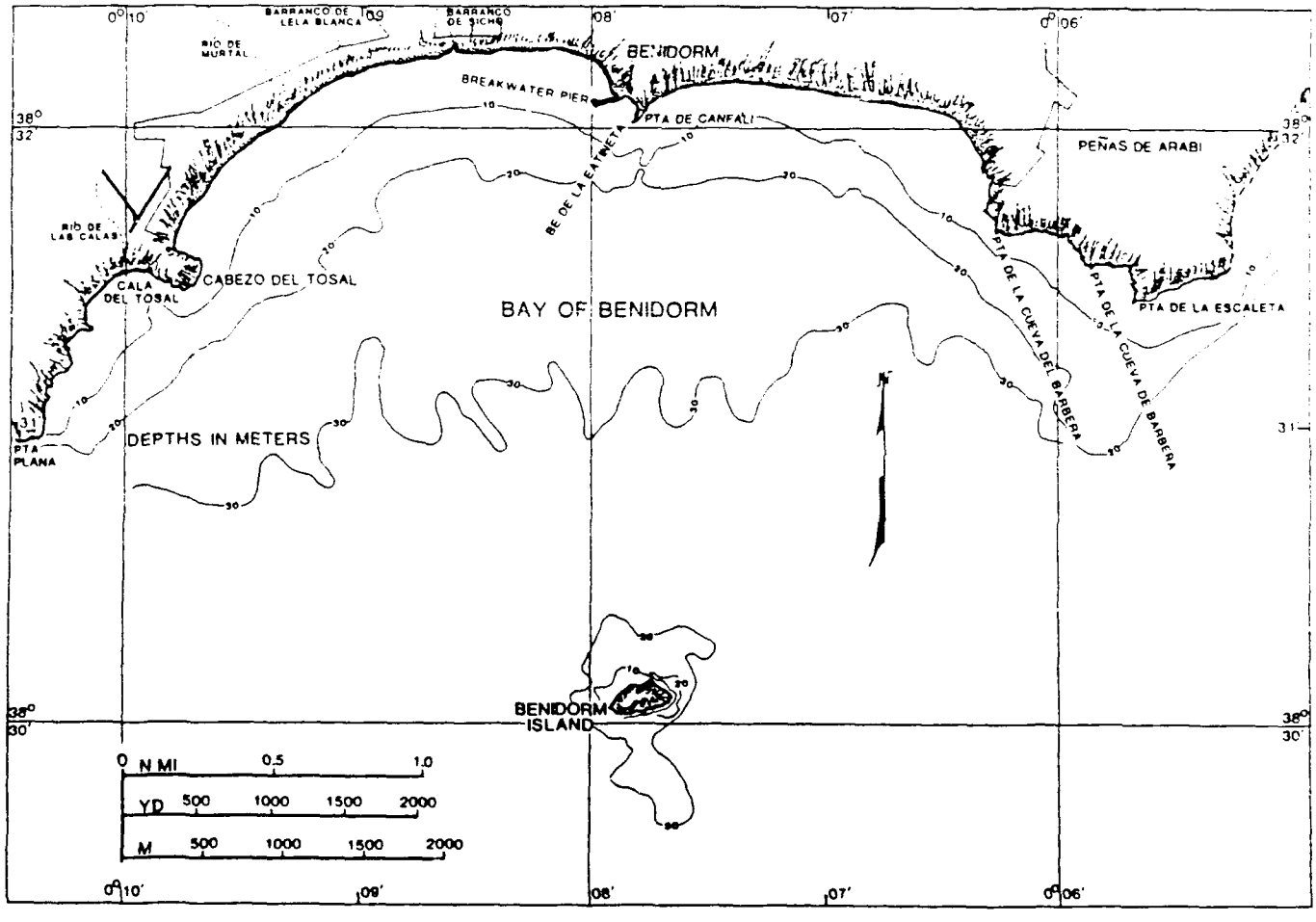

Figure 3-3. Bay of Benidorm.

3.2 Qualitative Evaluation of the Port of Benidorm

The non-carrier anchorage is approximately 750 yards (685 m) southwest of the end of the breakwater pier in depths of 65 to 80 feet (20 to 25 m). Holding ground is mud and seaweed. Carrier anchorage is 2200 yards (2013 m) south-southwest of the other anchorage in depths of 105 to 115 feet (32 to 35 m). Holding ground is sandy.

Fleet landing is on the north side of the pier near the yacht harbor. The pier extends toward the southwest and is well protected by a high, rocky breakwater on the seaward side (FICEURLANT, 1985).

The port is somewhat protected by mountains to the north and west and by hills to the northeast through east-southeast. It is open to winds from the southwest, south and southeast. The anchorage areas are similarly exposed but with additional exposure to easterly winds, especially at the carrier anchorage. Although the port is not exposed to easterly winds, easterly swell will traverse along the coastline and be felt at the breakwater pier. Easterly swell will also affect both anchorage areas. The easterly wind, known as the Levante, can occur anytime of the year but is stronger in winter and early spring. A summertime Levante often seems as strong as a winter Levante due to enhancement by the afternoon sea breeze. Because the Bay of Benidorm is exposed to the south, the most troublesome conditions are southwesterly to southeasterly winds. These winds precede cold fronts which usually occur in the cooler months.

3.3 Currents and Tides

As with other east coast ports of Spain, currents and tides are negligible.

3.4 Visibility

Visibility is normally good. In the late winter and early spring months morning fog will occasionally reduce visibility to a mile or so, but is usually 5 miles by late morning or noon. On that rare occasion when visibility is reduced to zero, it will occur in the early morning and last only an hour or two.

3.5 Wind and Weather

Benidorm is situated in an area dominated by generally good weather year-round. The area normally will not feel the full effects of Mediterranean wind regimes such as the Mistral, Poniente, and Levante. The Vendaval (southwesterly) and the Sirocco (southeasterly) are the only two winds which are felt with full force at Benidorm. Although the Levante occurs in all months, the port is protected from its full strength. The following paragraphs discuss these winds and their effects on the Port on Benidorm. Except where noted, this information is adapted from Brody and Nestor, 1980.

3.5.1 Levante

The Levante is an easterly or northeasterly wind that occurs in an area from the coast of southern France to west of the Strait of Gibraltar. It can occur as a result of several different weather patterns. The most typical situation is when the Azores High extends northeastward over Spain and southern France. With a large anticyclone over western Europe and relatively low pressure over the western Mediterranean, the Levante will be widespread. The Levante will also precede the arrival of a cold

front from the Atlantic during the cool season (November through April), when a lee depression or trough forms in the region off the coast of Spain. A third situation is when an intense cyclone is south of the Balearics. A gale force Levante can be expected along the east coast of Spain. These storms can, in rare instances, be extremely destructive causing widespread flooding and wind damage. Another pattern which results in the Levante is when a migratory low moves eastward in southern Spain to a position near the Greenwich Meridian. In this case gale northeasterlies can be expected off the east coast of Spain as far east as Ibiza.

Levante wind speeds in the Benidorm area are usually moderate (15 to 20 kt) and speeds greater than 33 kt are rare. Climatology statistics shown that winds from the eastern quadrant occur 20 to 30 percent of the time in cooler months and 50 to 60 percent of the time in the warmer months. Because the Bay of Benidorm is open to the south and high terrain is located to the east, the port and beach area of Benidorm is protected from the Levante. The anchorage area, however, is somewhat more exposed and not as well protected. Swell waves can come into the port area because they refract around and along the coast, even though the open sea Levante is northeasterly. Again, the anchorage area is more exposed than the port area. In warmer months, the afternoon sea breeze can enhance the Levante winds resulting in wind speeds of 20 to 25 kt.

3.5.2 Vendaval

Vendaval winds are southwesterlies which precede cold fronts and are most likely to occur in the cool season with gale force intensity (34 to 47 kt). Precipitation usually accompanies the Vendaval/cold front system but can be delayed by as much as 12 hours after the onset of the Vendaval.

Strong southwesterly to westerly winds are common during the cool season along the Costa Blanca. The synoptic situation producing these winds is characterized by an intensifying high pressure area that lies south of the Azores, with a deep low in the Atlantic approaching the British Isles and the coast of Europe, thereby resulting in a steepening pressure gradient between the high and low. Vendaval winds occur 20 percent of the time during the non-summer months. However, within the past few years, a summer-time episode of 25 to 30 kt southwesterlies lasted off and on for three days. Crew were stranded ashore as 6 to 10 foot (2 to 3 m) waves forced cancellation of boating.

3.5.3 Poniente

The Poniente wind is a northwesterly to westerly wind behind the cold front and usually occurs in the cool season; however, northwesterlies often occur in other seasons when high pressure builds in from the Atlantic. Consequently, the Poniente can be expected year-round with peak frequency and peak intensity during the cool season. In winter, the Azores High is displaced southward, resulting in northwesterlies in the Benidorm area which will last for days. During these episodes, winds will average 15 kt with peaks to 30 kt. The port area of Benidorm is protect from westerly and northwesterly winds by high terrain. Poniente winds occur 20 to 25 percent of the time in the summer months and 50 to 60 percent of the time the rest of the year.

3.5.4. Scirocco

The Scirocco (southeasterly) wind is not normally strong in the Benidorm area. However, approximately three times per year, the Scirocco will bring dust and rain ('red rain') to the area. These winds normally occur in the warm sector of cyclones and/or prior to fronts which extend from the Mediterranean southward to North Africa. The dust laden air picks up moisture as it

moves northward across the water, arriving in Spain with low clouds, rain or fog. Temperatures during Scirocco events are warm in winter and hot in spring and summer.

3.5.5. Mistral

The Mistral is a cold, strong northwesterly to north-northwesterly wind flowing offshore across the entire coast of the Gulf of Lion, often extending southward along the coast of Spain (For a complete description of the Mistral, see the Severe Weather Guide for Marseille or Toulon). Between Spain's east coast and the Balearic Islands, the Mistral is northeasterly. On rare occasions, easterly winds reach 25 kt in the Benidorm area. The immediate port area is protected from Mistral winds by a mountain to the north of the city. Three to six foot (1 to 2 m) easterly swell can occur at the anchorage areas during and for sometime after a strong Mistral episode.

3.6 Seasonal Summary of Weather Conditions

The seasonal patterns in the western Mediterranean area will vary in response to the movement of the Azores High. This high moves southward during winter, allowing low pressure systems to move in over Europe. The high builds northward and extends eastward over Spain as summer approaches and storms affecting the western Mediterranean become less frequent; in the middle of summer they are nearly non-existent. Much of the information in this section is adapted from Brody and Nestor, 1980.

A. Winter (November through February)

The easterly (Levante) wind is stronger in winter and spring. It will precede the arrival of cold fronts from the Atlantic. The prefrontal Levante may turn into a southwesterly wind (Vendaval) and reach gale force in wintertime. Once the front has passed, the winds will turn northwesterly (Poniente).

When there is an intense low south of the Balearic Islands, gale Levante winds can be expected along Spain's entire eastern coast.

The most common wind direction in winter is from the west and northwest, both of which have little impact on Benidorm. These winds can last for days, averaging 10 to 15 knots with occasional peaks to 25 kt. Because of fetch limitations, high seas usually do not hamper operations.

Below freezing temperatures are rare. No long-term weather records are available for Benidorm. However, Valencia, located on the coast to the north, averages only two days per year (usually in February) where the temperature drops below freezing. Valencia's record minimum is 19°F (-7°C) and could, if combined with high winds, cause hazardous wind chill.

Precipitation amounts are typical of the Mediterranean climate. Valencia's yearly total is about 15 inches per year and 40 percent of it is recorded during September, October and November. It is likely that Benidorm's precipitation amounts are similar.

B. Spring (March through May)

Springtime in the western Mediterranean is noted for periods of stormy winter-like weather alternating with false starts of summer. Temperatures are warming, and storm events are decreasing in both strength and frequency. Sea breezes begin to occur on warm days. Thunderstorms appear in April.

C. Summer (June through September)

Summers are characterized by the almost constant light to moderate wind. Both the Levante and the Poniente are common in summer, although neither is very intense. Temperatures are warm with record maximums over 100°F (38°C). Precipitation amounts are minimal until September when the rainy season begins. The sea

breeze regime is a daily occurrence except when interrupted by either the Levante or the Vendaval.

Thunderstorms continue to occur throughout summer. Typically these storms are highlighted by thunder and lightning but with very little rain and will move from the southwest toward the northeast offshore, bypassing the city of Benidorm. In rare instances, gusts to 45 kt and hail will occur.

D. Autumn (October)

The autumn season is a short, transitional period lasting only for the month of October. By month's end, an abrupt change to winter-like weather has taken place.

3.7 Local Indicators of Hazardous Weather Conditions

The following 'forecaster hints' are adapted from Brody and Nestor, 1980:

* Correct placement of fronts is very difficult in the western Mediterranean basin due both to the lack of ship reports and to terrain effects. These problems are accentuated during the summer when fronts are weakest. The worst locations in this respect are Spain and the Balearic Islands. Forecasters should be aware of the lee trough which develops along the east coast of Spain during periods of northwesterly flow. There is a tendency to designate this trough as frontal, instead of correctly moving the front eastward, out of the region.

* Surface cyclones generally weaken while traversing Spain, then deepen rapidly when they reach the east coast of Spain.

* The strong northwesterlies (see 3.5.3) resulting from passage of an upper level trough will occur at Zaragoza (08161) three to six hours before occurring along Spain's east coast.

3.8 Protective and Mitigating Measures

Local maritime personnel have indicated that protective measures are needed only on rare occasions. In previous years some four dozen U.S. Navy ship visits have been made in Benidorm,usually in the summer months, and no ship has had to leave port due to weather. The most likely operation to be interrupted is boating. In a strong wind event (or swell from a Levante or Mistral) boating may be hazardous. Normal delays are measured in hours rather than days, with some rare exceptions. Within the past few years, a summer-time episode of 25 to 30 kt southwesterlies lasted off and on for three days. In summer, the combination of a Levante and an afternoon sea breeze may disrupt boating. Morning runs should be scheduled if at all possible.

Scirocco rains, averaging three episodes per year, can cause problems for unprotected equipment. The 'red rain' is caused by fine dust in the raindrops. The rain/dust can seep through equipment vents and seams, causing shorts and other malfunctions.

In the rare event of high winds and waves, the closest, protected harbor is Alicante, to the south.

3.9 Summary of Problems and Actions

Table 3-1 is intended to provide easy-to-use seasonal references for meteorologists on ships using the port of Benidorm. Table 2-1 (Section 2) summarizes Table 3-1 and is intended primarily for use by ship captains.

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Table 3-1. Potential problem situations at the Port of Benidorm, S

VESSEL LOCATION/SITUATION	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	AC
1. Anchorages Occurs year-round, strongest in winter and spring.	a. Levante Winds/waves - E'ly/NE'ly wind affects anchorage area - minimal affects at fleet landing. Caused by Azores high extending into Spain or with a low pressure system to the south of the Balearic Islands. In the cool season, usually accompanied by low clouds and rain. E'ly to SE'ly Levante will often precede cold fronts in winter/early spring.	a. Anchorages affected more than port/fleet landing area. Levante effect minimized due to terrain to east of bay. However, swell tends to bend around the coastline and will come into the port/fleet landing area. Swell will be higher at anchorages. In rare instance of severe Levante, protection can be sought in Alicante, to the south.	
Occurs year-round, strongest in winter and spring.	b. Vendaval winds - SW'ly to W'ly winds which precede cold fronts and are most likely to occur in the cool season with gale force intensity (30+ kt). Precipitation usually accompanies the Vendaval/cold front system but can be delayed by as much as 12 hours after Vendaval wind onset.	b. In rare cases, high winds and waves at the anchorage areas may force ships to protect at sea. Intense Vendaval episodes are usually of short duration (3-6 hrs) and waves do not build to great heights. A more southerly Vendaval direction will bring higher waves to the anchorage than will southwest or westerly Vendavals due to fetch distances.	
Occurs in winter and spring.	c. Mistral winds/waves - Swell from a mistral event in the Gulf of Lion can extend as far south as Benidorm. Mistral winds of 25+ kt can occur 1 or 2 times per year. More often (2-3 times per year), swell, with or without the wind, will occur. This swell is long period (15 sec) and is usually less than 8 ft.	c. High swell will likely be more of a problem than will high winds. During the Mistral, offshore, waves and winds will be from the northeast. Winds will not normally affect Benidorm but long period swell (15 sec), bending around the coastline, may cause excessive motion on ships with critical response characteristics. Wind chill may be a factor in winter.	

ıations at the Port of Benidorm, Spain - ALL SEASONS

TIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
ore than port/fleet landing area. ced due to terrain to east of bay. t to bend around the coastline and t fleet landing area. Swell will . In rare instance of severe be sought in Alicante, to the	a. The Levante can occur with several different weather patterns but in the most typical situation, it occurs when the Azores High extends northeastward over Spain and southern France. Also, the Levante will precede the arrival of a cold front during the cool season. In this case, a lee trough forms in the region of the Balearic Islands. At times, an intense low will form south of the Balearics and gale force (30+ kt) can be expected along the east coast of Spain. A low NE or ENE swell may be observed 12 hours prior to the Levante wind onset. Note, however, that this swell may be due to a Mistral in the Gulf of Lion and not associated with a Levante.
nds and waves at the anchorage to protect at sea. Intense nerally of short duration (3-6 hrs) to great heights. A more rection will bring higher waves n will southwest or westerly r distances.	b. *The most intense and frequent Vendaval winds are associated with* cold fronts. However, strong southwesterly to westerly winds can occur at Benidorm when a high lying south of the Azores tries to build northward. Any cold front approaching Spain's east coast from the west has the potential to cause strong Vendaval winds. Note that fronts will weaken as they approach the coast but will intensify once passing the coast and interacting with the lee trough.
be more of a problem than will high stral, offshore, waves and winds will t. Winds will not normally affect Benidorm 15 sec), bending around the coastline, motion on ships with critical response still may be a factor in winter.	c. A strong mistral event (40+ kt) in the Gulf of Lion will normally produce some swell in the Benidorm area (see Severe Weather Guide for Marseille or Toulon for details).

Table 3-1 (continued)

VESSEL LOCATION/SITUATION	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
2. Arriving/Departing Occurs year-round, strongest in winter and spring.	a. Levante Winds/waves - E'ly/NE'ly wind affects anchorage area - minimal affects at fleet landing. Caused by Azores high extending into Spain or with a low pressure system to the south of the Balearic Islands. In the cool season, usually accompanied by low clouds and rain. E'ly to SE'ly Levante will often precede cold fronts in winter/early spring.	a. Caution must be used on departure to the east or north. The bay is protected from high waves but after passing the land's shelter wave heights increase dramatically. Highest waves will most likely be from the ENE and heading into them will maximize ship's roll.
Occurs year-round, strongest in winter and spring.	b. Vendaval winds - SW'ly to W'ly winds which precede cold fronts and are most likely to occur in the cool season with gale force intensity (30+ kt). Precipitation usually accompanies the Vendaval/cold front system but can be delayed by as much as 12 hours after Vendaval wind onset.	b. Setting anchors can be difficult during frontal passage. Southerly winds and waves will precede front then winds will switch to westerly and cross the waves at an angle. If the Vendaval is southwest or west, waves will be at a minimum but winds will affect those vessels with large sail area.
Occurs in winter and spring.	c. Mistral winds/waves - Swell from a mistral event in the Gulf of Lion can extend as far south as Benidorm. Mistral winds of 25+ kt can occur 1 or 2 times per year. More often (2-3 times per year), swell, with or without the wind, will occur. This swell is long period (15 sec) and is usually less than 8 ft.	c. Winds are usually not strong with a mistral at Benidorm. However, waves outside the harbor can be hazardous. Use caution on departure as wave heights increase sharply outside land's shelter. A southerly heading after departure will minimize the swell effect while an easterly heading will put the swell on the beam. Wind chill can be a factor in winter.

ontinued)

ARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
VA arture to the east or north. ch waves but after passing ds increase dramatically. be from the ENE and ship's roll.	a. The Levante can occur with several different weather patterns but in the most typical situation, it occurs when the Azores High extends northeastward over Spain and southern France. Also, the Levante will precede the arrival of a cold front during the cool season. In this case, a lee trough forms in the region of the Balearic Islands. At times, an intense low will form south of the Balearics and gale force (30+ kt) can be expected along the east coast of Spain. A low NE or ENE swell may be observed 12 hours prior to the Levante wind onset. Note, however, that this swell may be due to a Mistral in the Gulf of Lion and not associated with a Levante.
...t during frontal waves will precede t westerly and cross Vendaval is southwest eam but winds will the sail area.	b. The most intense and frequent Vendaval winds are associated with cold fronts. However, strong southwesterly to westerly winds can occur at Benidorm when a high lying south of the Azores tries to build northward. Any cold front approaching Spain's east coast from the west has the potential to cause strong Vendaval winds. Note that fronts will weaken as they approach the coast but will intensify once passing the coast and interacting with the lee trough.
with a mistral at Benidorm. arbor can be hazardous. Use e heights increase sharply sterly heading after swell effect while an swell on the beam. Wind nter.	c. A strong mistral event (40+ kt) in the Gulf of Lion will normally produce some swell in the Benidorm area (see Severe Weather Guide for Marseille or Toulon for details).

Table 3-1 (Continued)

VESSEL LOCATION/SITUATION	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
3. Small Boats Occurs year-round, strongest in winter and spring.	a. Levante Winds/waves - E'ly/NE'ly wind affects anchorage area - minimal affects at fleet landing. Caused by Azores high extending into Spain or with a low pressure system to the south of the Balearic Islands. In the cool season, usually accompanied by low clouds and rain. E'ly to SE'ly Levante will often precede cold fronts in winter/early spring.	a. Runs to/from the anchorages may be curtailed due to hazardous winds/waves at the anchorages. Both wind and waves (generally swell) will be greater at the anchorages than at fleet landing.
Occurs year-round, strongest in winter and spring.	b. Vendaval winds - SW'ly to W'ly winds which precede cold fronts and are most likely to occur in the cool season with gale force intensity (30+ kt). Precipitation usually accompanies the Vendaval/cold front system but can be delayed by as much as 12 hours after Vendaval wind onset.	b. Runs to/from the anchorages may be curtailed due to hazardous winds/waves at the anchorages and at fleet landing. If Vendaval is southerly expect stronger winds and waves than from southwesterly Vendaval. Winds can change direction quickly, especially in winter, causing waves to cross at dangerous angles to the winds and create hazardous conditions for small boats.
Occurs in winter and spring.	c. Mistral winds/waves - Swell from a mistral event in the Gulf of Lion can extend as far south as Benidorm. Mistral winds of 25+ kt can occur 1 or 2 times per year. More often (2-3 times per year), swell, with or without the wind, will occur. This swell is long period (15 sec) and is usually less than 8 ft.	c. Runs to/from the anchorages may be curtailed due to long period swell entering the bay from along the coast. On departure, winds/waves will increase once clear of land's shelter. Wind chill can be a factor in winter.

(continued)

...VASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
AN... ...tailed due to ... both wind and ... at the	a. The Levante can occur with several different weather patterns but in the most typical situation, it occurs when the Azores High extends northeastward over Spain and southern France. Also, the Levante will precede the arrival of a cold front during the cool season. In this case, a lee trough forms in the region of the Balearic Islands. At times, an intense low will form south of the Balearics and gale force (30+ kt) can be expected along the east coast of Spain. A low NE or ENE swell may be observed 12 hours prior to the Levante wind onset. Note, however, that this swell may be due to a Mistral in the Gulf of Lion and not associated with a Levante.
...tailed due to ...ee and at fleet ...t stronger winds ...eval. Winds can ... winter, causing ...the winds and ...boats.	b. The most intense and frequent Vendaval winds are associated with cold fronts. However, strong southwesterly to westerly winds can occur at Benidorm when a high lying south of the Azores tries to build northward. Any cold front approaching Spain's east coast from the west has the potential to cause strong Vendaval winds. Note that fronts will weaken as they approach the coast but will intensify once passing the coast and interacting with the lee trough.
...tailed due to long ...ng the coast. On ...ce clear of land's ...winter.	c. A strong mistral event (40+ kt) in the Gulf of Lion will normally produce some swell in the Benidorm area (see Severe Weather Guide for Marseille or Toulon for details).

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FICEURLANT, 1985: Port Directory for Benidorm (revised 1987). Fleet Intelligence Center Europe and Atlantic, Norfolk, VA.

Port Visit Information

JANUARY 1989. NOARL meteorologists R. Fett and D. Perryman met with the U.S. Navy husbanding agent, Mr. John Sparrowe, to obtain much of the information included in this port evaluation.

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* Formerly the Naval Environmental Prediction Research Facility.

APPENDIX A

General Purpose Oceanographic Information

This section provides some general definitions regarding waves and is extracted from H.O. Pub. No. 603, Practical Methods for Observing and Forecasting Ocean Waves (Pierson, Neumann, and James, 1955).

Definitions

Waves that are being generated by local winds are called "SEA". Waves that have traveled out of the generating area are known as "SWELL". Seas are chaotic in period, height and direction while swell approaches a simple sine wave pattern as its distance from the generating area increases. An in-between state exists for a few hundred miles outside the generating area and is a condition that reflects parts of both of the above definitions. In the Mediterranean area, because its fetches and open sea expanses are limited, SEA or IN- BETWEEN conditions will prevail. The "SIGNIFICANT WAVE HEIGHT" is defined as the average value of the heights of the one-third highest waves. PERIOD and WAVE LENGTH refer to the time between passage of, and distances between, two successive crests on the sea surface. The FREQUENCY is the reciprocal of the period (f = 1/T) therefore as the period increases the frequency decreases. Waves result from the transfer of energy from the wind to the sea surface. The area over which the wind blows is known as the FETCH, and the length of time that the wind has blown is the DURATION. The characteristics of waves (height, length, and period) depend on the duration, fetch, and velocity of the wind. There is a continuous generation of small short waves from the time the wind starts until it stops. With continual transfer of energy from the wind to the sea surface the waves grow with the older waves leading the growth and spreading the energy over a greater range of frequencies. Throughout the growth cycle a SPECTRUM of ocean waves is being developed.

A Beaufort Scale table with related wave effects is shown on the following page.

BEAUFORT SCALE

Beaufort Number	Wind Speed Knots	Wind Speed MPH	Seaman's term	Effects observed at sea	Term and height of Waves in meters
0	Under 1	Under 1	Calm	Sea like mirror.	Calm, glassy, 0
1	1-3	1-3	Light air	Ripples with appearance of scales; no foam crests.	
2	4-6	4-7	Light breeze	Small wavelets; crests of glassy appearance, not breaking	Rippled, less than 0.5
3	7-10	8-12	Gentle breeze	Large wavelets; crests begin to break; scattered whitecaps.	Smooth, 0.5
4	11-16	13-18	Moderate breeze	Small waves, becoming longer; numerous whitecaps.	Slight, 1.0
5	17-21	19-24	Fresh breeze	Moderate waves, taking longer form; many whitecaps; some spray.	Moderate, 1.0-2.5
6	22-27	25-31	Strong breeze	Larger waves forming; whitecaps everywhere; more spray.	Rough, 2.5-4.0
7	28-33	32-38	Moderate gale	Sea heaps up; white foam from breaking waves begins to be blown up in streaks.	
8	34-40	39-46	Fresh gale	Moderate high waves; edges of crests begin to break; foam is blown in streaks.	Very rough, 4.0-6.0
9	41-47	47-54	Strong gale	High waves; sea begins to roll; dense streaks of foam; spray may reduce visibility.	
10	48-55	55-63	Whole gale	Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility reduced.	High, 6.0-9.0
11	56-63	64-72	Storm	Exceptionally high waves; sea covered with white foam patches; visibility still more reduced.	Very high, 9.0-13.5
12	64-71	73-82	Hurricane	Air filled with foam; sea completely white with driving spray; visibility greatly reduced. Winds of force 12 and above very rarely experienced on land; usually accompanied by widespread damage.	Phenomenal, greater than 13.5
13	72-80	83-92			
14	81-89	93-103			
15	90-99	104-114			
16	100-108	115-125			
17	109-118	126-136			

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29I1	Frigate LANT (FF 1098)
29J1	Frigate LANT (FF 1040/1051 Class)
29K1	Frigate LANT (FF 1052/1077 Class)
29L1	Frigate LANT (FF 1078/1097 Class)
29N1	Submarine LANT (SSN)
29Q	Submarine LANT SSBN
29R1	Battleship Lant (2)
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31I1	Dock Landing Ship LANT
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31M1	Tank Landing Ship LANT
32A1	Destroyer Tender LANT
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32G1	Combat Store Ship LANT
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32S1	Repair Ship LANT
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32DD1	Submarine Tender LANT
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FD5	Oceanography Command Center - COMNAVOCEANCOM (Rota)

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This handbook for the port of Benidorm, one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.

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